

February 1997

Preliminary Data Summary

by Field Research Facility

U.S. Army Corps of Engineers
Waterways Experiment Station
Coastal and Hydraulics Laboratory
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Preface

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal and Hydraulics Laboratory's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

**Data from these reports are now available via the World Wide Web at
<http://www.frf.usace.army.mil>**

These web pages contain general information about the Field Research Facility and data from 1980 to the present.

Please note the new web address, <http://www.frf.usace.army.mil>

Your comments and criticisms are welcome.

Introduction

1

The U.S. Army Engineer Waterways Experiment Station, Coastal and Hydraulics Laboratory's (CHL) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.75 m above the National Geodetic Vertical Datum (NGVD) of the year 1929.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local bathymetric, oceanographic, and meteorological conditions. This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Clifford F. Baron at (919)261-6840 ext.222 (c.baron@cerc.wes.army.mil).

Chapter 2 presents the meteorological data; Chapters 3 through 6 present oceanographic data; Chapter 7 presents nearshore profiles and bathymetry; and Chapter 8, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used and their operational status during the month. Figure 2 shows weather and ocean conditions for the month. Table 2 and Figure 3 identifies the location of the instruments. The water depths at the wave gauges and current meters vary and may be determined from information contained in Figure 9. Other installation information is contained in Table 1.

Times given in the report are referenced to eastern standard time (EST).

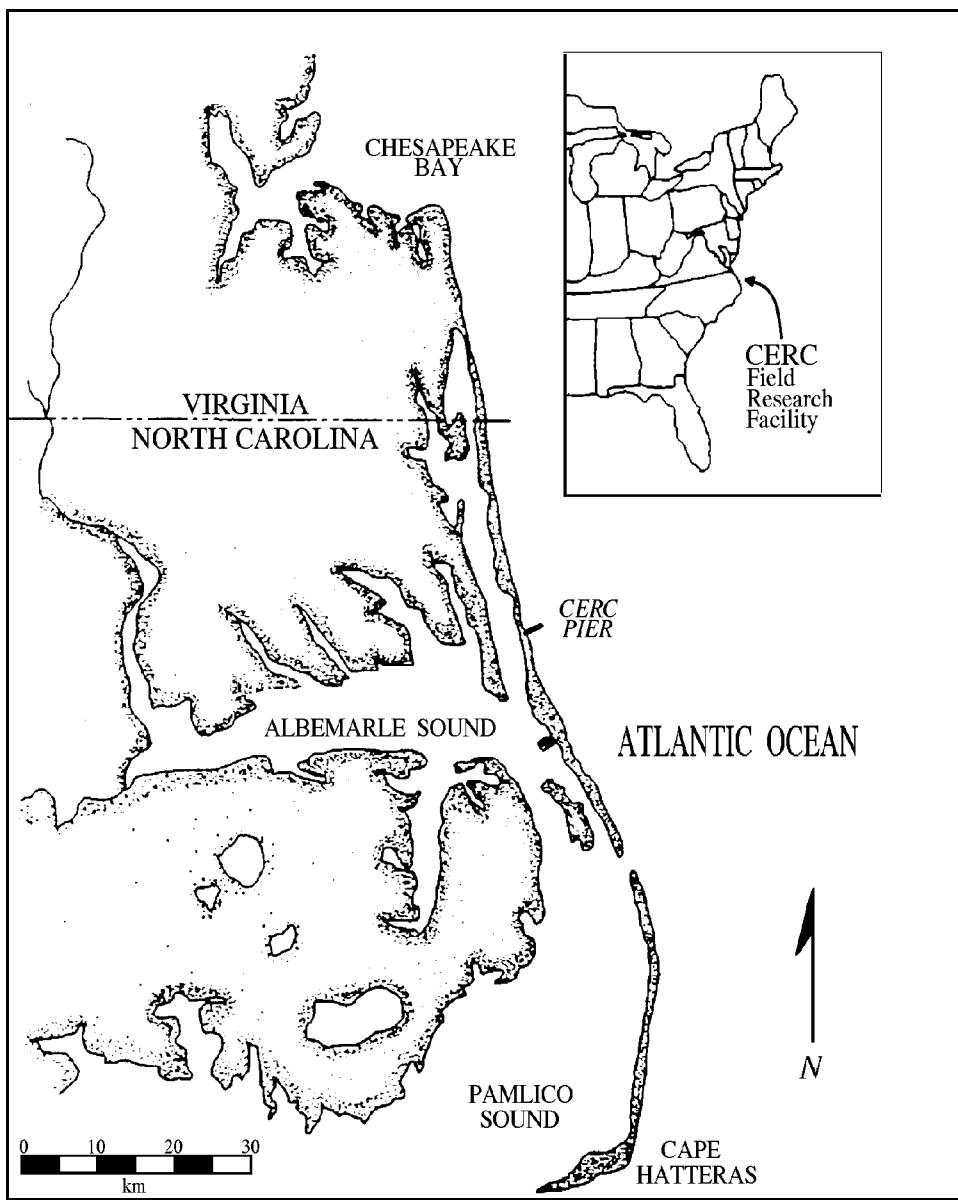


Figure 1. FRF Location Map

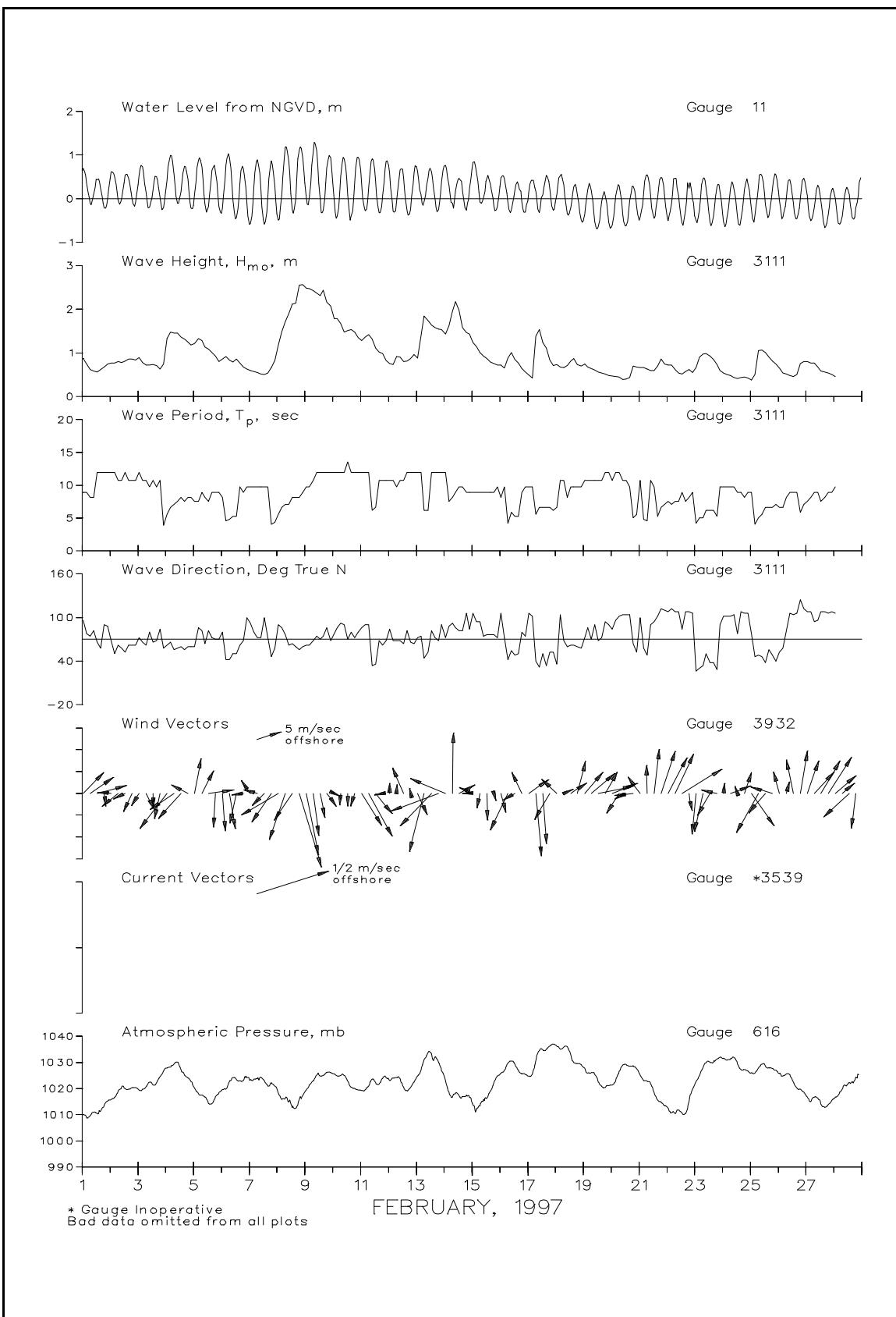


Figure 2. Month at a Glance

Table 1
Instrument Status/Data Availability

		February 1997																												
		Day of the month																												
Gauge	ID	Description/Remarks	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8
616	Atmospheric Pressure	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
604	Precipitation	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
624	Air Temperature	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
3932	Anemometer	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
641	Pressure Gauge on FRF pier	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
625	Baylor staff on FRF pier	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
3111	8 Meter Array 309 m north of FRF	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
111	Pressure Gauge center of 8 Meter Array	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
630	Waverider buoy 4.0 km offshore	Gauge Status	*	*	*	*	*	*	*	*	*	*	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		Data Collected	*	*	*	*	*	*	*	*	*	*	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3539	Current meter 343 m north of FRF pier (1.6 km offshore)	Gauge Status	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
		Data Collected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
11	NOAA tide gauge at end of pier	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Visual Observations		Daily	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
(daily oceanographic and meteorological observations)																														
Gauge Status			*	= Operational	/	= Partial	-	= Non-Operational																						
Data Collected			*	= All	/	= Partial	-	= None																						
Visual Observations			*	= Complete	/	= Partial	-	= None																						

Table 2
Gauge Locations

Gauge*	Description	* Latitude	* Longitude	* FRF Coordinates	* Gauge Depth	* Water Depth
ID *		* Degrees N	* Degrees W	* CrossshoreT Longshore*	NGVD, m	* NGVD, m
616	* Atmospheric Pressure*	36 10' 57.03"	* 75 45' 5.50"	* 11.60	* 569.00	* -----
3932	* Anemometer	* 36 11' 1.23"	* 75 44' 43.07"	* 585.20	* 517.30	* 19.50
641	* Pressure Gauge	* 36 10' 57.71"	* 75 44' 56.23"	* 239.11	* 516.64	* -1.64
625	* Baylor Staff	* 36 11' 1.04"	* 75 44' 43.72"	* 568.00	* 516.64	* Surface
3111	* 8 Meter Array North	* 36 11' 19.14"	* 75 44' 36.41"	* 915.23	* 990.16	* -7.50
						* -7.90
	* 8 Meter Array South	* 36 11' 11.28"	* 75 44' 33.28"	* 914.20	* 735.37	* -7.42
						* -7.90
	* 8 Meter Array East	* 36 11' 13.70"	* 75 44' 32.56"	* 954.51	* 800.58	* -7.62
						* -8.13
	* 8 Meter Array West	* 36 11' 12.48"	* 75 44' 37.11"	* 834.66	* 800.37	* -6.98
						* -7.44
111	* Pressure Gauge in center of 8 M Array	* 36 11' 14.06"	* 75 44' 34.39"	* 914.43	* 825.52	* -7.76
						* -8.08
630	* Waverider Buoy	* 36 10' 5.10"	* 75 41' 59.30"	* 3934.96	* -2400.81	* Surface
						* -17.00
3539	* Current Meter	* 36 11' 23.57"	* 75 44' 9.12"	* 1605.80	* 907.60	* -11.60
						* -11.70
11	* NOAA Tide Gauge	* 36 11' 1.25"	* 75 44' 42.60"	* 596.49	* 514.20	* Surface
						* -7.62
R	R	R	R	R	R	R

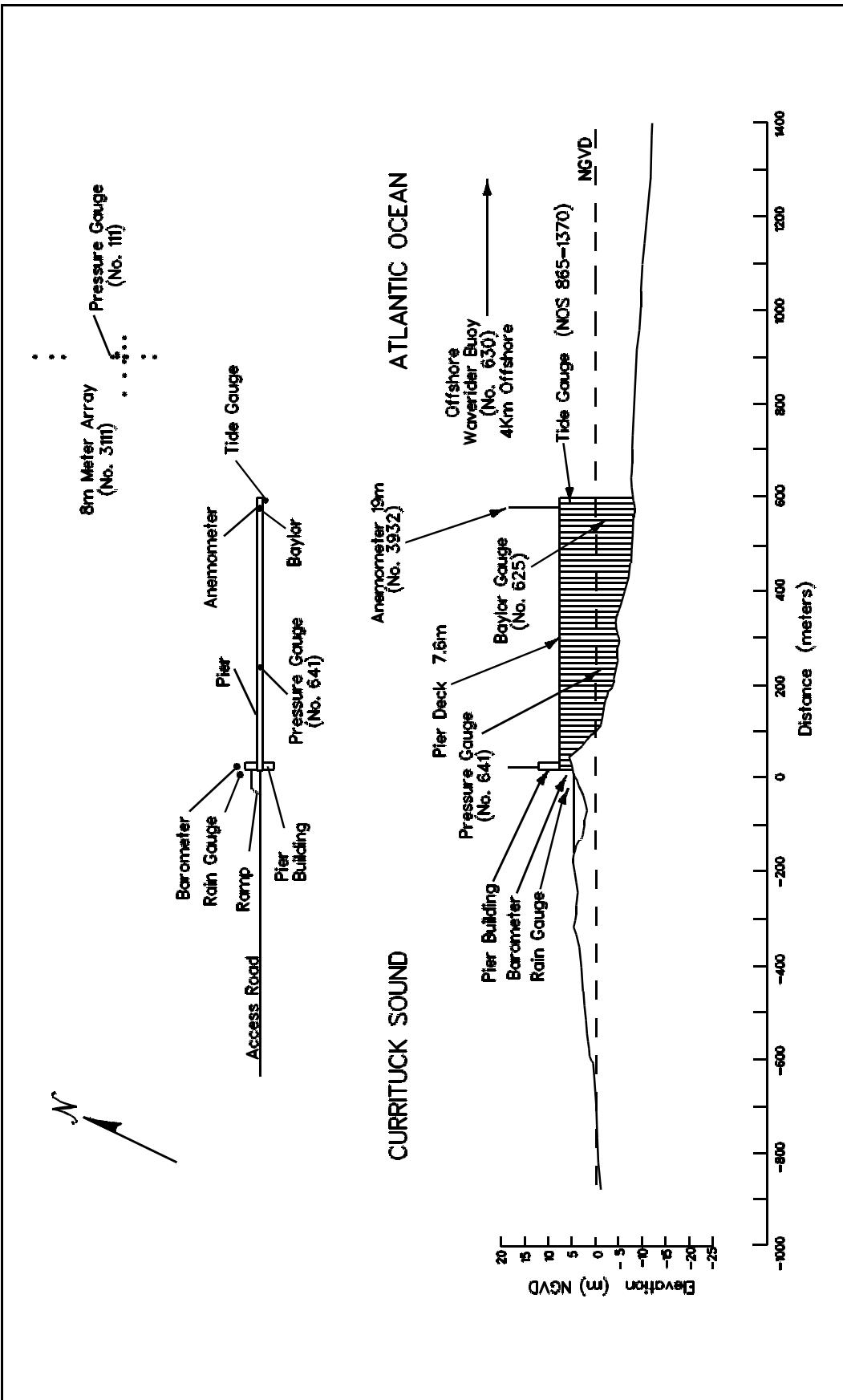


Figure 3. Instrument Locations, Elevations From NGVD

Meteorological Data

2

A variety of instruments have been installed at the FRF (Figure 3) to monitor the meteorological conditions. The data presented in Table 3 are collected and stored using a Digital Equipment Corporation VAXstation 4000. For each instrument identified in Table 1, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m using a WeatherMeasure Skyvane anemometer. Monthly resultant wind speeds and directions (Figure 4) are determined by vector averaging the data. Wind directions (Table 3) indicate where the wind is coming from. Temperature and atmospheric pressure means (Table 3) are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 3 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

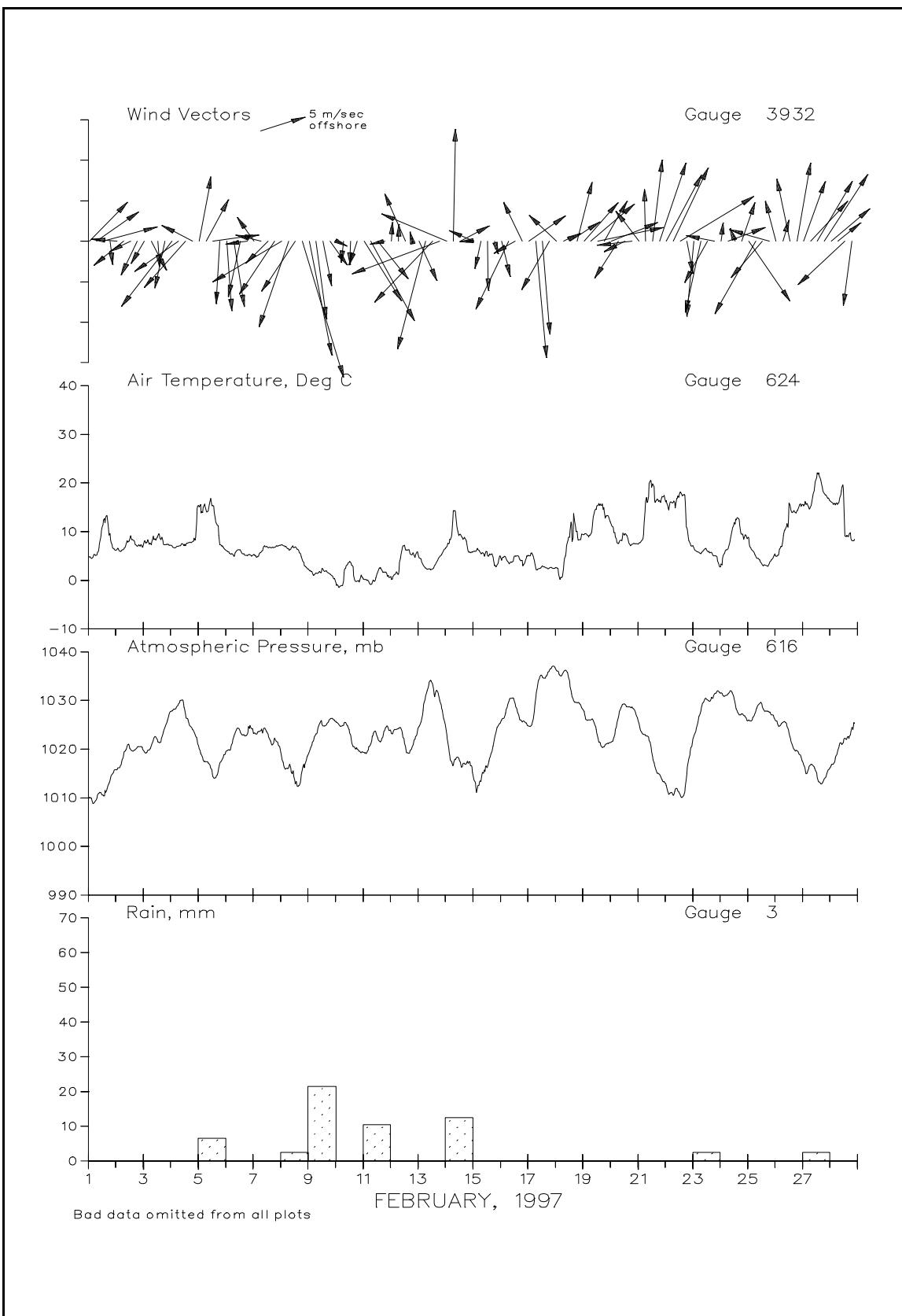


Figure 4. Meteorological Monthly Summary

Table 3
Meteorological Data

Feb 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	6	220	4.8	1010.1	0
	700	6	231	5.2	1009.7	0
	1300	6	253	11.4	1010.6	0
	1900	3	354	9.6	1013.6	0
2	100	3	95	6.4	1015.8	0
	700	4	46	6.4	1018.9	0
	1300	3	60	9.2	1019.9	0
	1900	4	22	7.0	1020.4	0
3	100	3	27	8.0	1019.5	0
	700	4	1	7.3	1020.6	0
	1300	3	1	9.2	1021.4	0
	1900	6	10	7.3	1024.5	0
4	100	10	33	7.1	1027.9	0
	700	6	51	7.0	1029.4	0
	1300	7	37	7.1	1027.2	0
	1900	4	121	7.9	1024.1	0
5	100	8	188	15.1	1020.2	0
	700	6	204	14.4	1017.5	7
	1300	5	261	15.4	1014.4	0
	1900	8	2	7.3	1017.1	0
6	100	9	356	6.1	1019.7	0
	700	8	352	4.9	1022.6	0
	1300	7	10	6.2	1023.4	0
	1900	2	81	5.1	1023.2	0
7	100	3	148	5.3	1023.4	0
	700	3	1	5.7	1023.9	0
	1300	4	40	6.7	1023.2	0
	1900	8	30	6.8	1022.3	0
8	100	9	55	7.3	1018.3	0
	700	11	16	6.5	1016.2	3
	1300	7	30	6.9	1012.9	0
	1900	17	1	4.2	1015.8	0
9	100	14	1	2.0	1019.5	0
	700	10	1	1.5	1023.1	21
	1300	6	1	2.3	1024.8	0
	1900	3	327	1.3	1026.2	0
10	100	1	297	-1.1	1025.5	0
	700	3	6	-0.2	1024.9	0
	1300	3	1	3.7	1023.0	0
	1900	3	16	-0.2	1020.0	0

Table 3
Meteorological Data (continued)

Feb 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
11	100	8	331	0.1	1019.3	0
	700	11	334	-0.9	1021.0	10
	1300	6	325	1.7	1022.4	0
	1900	2	77	1.7	1023.9	0
12	100	2	181	0.1	1023.2	0
	700	2	181	1.2	1024.2	0
	1300	6	159	6.3	1020.6	0
	1900	1	167	5.2	1020.4	0
13	100	5	338	4.6	1024.7	0
	700	14	12	2.5	1031.1	0
	1300	10	39	2.3	1033.4	0
	1900	10	66	4.8	1030.1	0
14	100	8	116	6.9	1023.1	0
	700	14	180	14.3	1016.7	12
	1300	4	238	9.5	1017.3	0
	1900	1	86	6.8	1017.5	0
15	100	3	1	5.9	1013.8	0
	700	3	10	5.4	1013.4	0
	1300	6	359	5.0	1016.4	0
	1900	2	346	3.0	1022.3	0
16	100	4	347	4.1	1026.0	0
	700	9	22	3.6	1029.7	0
	1300	3	56	5.0	1029.4	0
	1900	5	157	4.1	1025.6	0
17	100	5	231	5.0	1024.8	0
	700	14	355	2.4	1030.6	0
	1300	12	356	3.0	1034.8	0
	1900	7	26	2.6	1036.3	0
18	100	4	137	2.5	1036.1	0
	700	2	242	2.5	1035.9	0
	1300	4	232	10.3	1032.9	0
	1900	7	192	10.1	1029.6	0
19	100	6	217	9.4	1027.8	0
	700	6	225	9.5	1026.1	0
	1300	7	256	15.3	1022.6	0
	1900	5	205	14.1	1020.5	0
20	100	5	244	11.5	1021.4	0
	700	5	28	7.5	1026.6	0
	1300	3	60	9.6	1029.2	0
	1900	4	82	7.4	1028.8	0

Table 3
Meteorological Data (concluded)

Feb 1997						
Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed m/sec	Direction deg TN	deg C	Pressure mb	mm
21	100	4	146	7.6	1025.3	0
	700	6	178	16.2	1022.8	0
	1300	10	185	19.8	1018.5	0
	1900	10	196	16.4	1014.8	0
22	100	9	204	16.4	1012.6	0
	700	10	202	16.0	1010.5	0
	1300	10	234	18.1	1010.7	0
	1900	4	351	10.8	1015.0	0
23	100	9	4	6.7	1022.7	0
	700	9	10	5.5	1027.9	3
	1300	6	25	6.0	1030.1	0
	1900	3	103	5.0	1031.4	0
24	100	2	184	3.4	1031.6	0
	700	4	246	6.5	1031.5	0
	1300	2	162	11.5	1029.4	0
	1900	5	196	9.5	1027.3	0
25	100	9	329	8.7	1026.0	0
	700	10	25	4.9	1027.8	0
	1300	6	36	3.1	1028.7	0
	1900	4	108	3.4	1027.6	0
26	100	5	166	4.9	1025.8	0
	700	3	193	8.2	1025.5	0
	1300	8	169	15.5	1022.5	0
	1900	10	188	14.3	1019.7	0
27	100	8	197	15.3	1016.8	0
	700	6	218	15.1	1016.8	2
	1300	8	206	22.1	1014.2	0
	1900	9	209	17.9	1013.9	0
28	100	6	225	16.1	1016.7	0
	700	3	226	15.8	1019.8	0
	1300	7	42	9.0	1022.3	0
	1900	8	6	8.1	1024.5	0
		Resultant		Mean	Mean	Total
		—	—	7.5	1022.7	58

Wave Data

3

Wave data are collected from three different sets of instruments, as shown in Table 1 and Figure 3. The first is an array of fifteen pressure gauges, collectively referred to as gauge 3111 (gauge 111 being one of them). Directional information is computed from these gauges using a iterative maximum likelihood estimator. The second is a Baylor staff gauge (625) and a pressure gauge (641), both attached to the pier. The third is a Waverider buoy (630). The data are collected, analyzed, and stored on optical disc using a Digital Equipment Corporation VAXstation 4000. Data is sampled at 2 hertz, with five contiguous 34 minute records, for a total collection period of nearly 2 hours and 51 minutes. This report reflects the data collection periods of 0100, 0700, 1300, and 1900 EST. The results are based only on the first 34 minute record. The exception is the 8 Meter Array (3111) which condenses the first four records into one statistical value.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gauge has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 degrees of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum.

Table 4 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 4 are average values computed from this data. Figure 5 is a time history of all H_{mo} and T_p values obtained for all gauges.

Differences in wave periods between wave gauges (Table 4 and Figure 5) may be the result of wave breaking, wave reformation, the presence of multiple wave trains containing nearly equal energy, and statistical variations in spectral estimations.

Table 4
Wave Data

Feb 1997										
Day	Hour	641		625		3111			630	
		Pressure Hmo,m	Gauge Tp,sec	Baylor Hmo,m	Gauge Tp,sec	8 Meter Hmo,m	Array Tp,sec	Dir,TN	Waverider Hmo,m	Tp,sec
1	0100	0.55	8.9	0.85	8.9	0.87	8.9	96	0.91	8.4
	0700	0.33	8.9	0.62	8.9	0.62	8.2	74	0.80	8.4
	1300	0.33	12.2	0.47	11.2	0.56	12.0	66	0.67	12.6
	1900	0.34	10.3	0.59	9.9	0.68	12.0	90	0.69	11.8
2	0100	0.44	11.7	0.64	10.7	0.77	12.0	68	0.77	12.6
	0700	0.47	12.2	0.69	11.2	0.80	10.8	62	0.79	11.2
	1300	0.59	10.7	0.79	11.2	0.81	12.0	52	0.81	11.8
	1900	0.62	10.7	0.87	11.2	0.86	10.8	62	1.03	11.2
3	0100	0.57	11.7	0.89	11.7	0.90	12.0	72	1.03	11.2
	0700	0.42	10.7	0.75	10.3	0.72	10.8	62	0.90	11.2
	1300	0.39	10.7	0.73	10.3	0.73	10.8	66	0.80	9.1
	1900	0.36	10.7	0.65	8.6	0.63	10.8	84	0.76	9.1
4	0100	0.80	4.7	1.13	5.1	1.33	5.6	62	1.37	4.6
	0700	1.08	7.0	1.37	7.0	1.46	7.1	56	1.69	6.3
	1300	0.94	6.8	1.31	7.6	1.36	8.2	60	1.67	7.7
	1900	0.96	7.2	1.24	8.6	1.25	8.2	60	1.41	8.4
5	0100	0.66	8.1	1.08	7.8	1.22	7.6	60	1.31	7.7
	0700	0.82	7.8	1.22	8.6	1.28	8.9	82	1.45	8.4
	1300	0.59	7.6	1.06	7.2	1.09	7.6	82	1.28	8.4
	1900	0.62	7.8	0.88	7.4	0.92	8.9	70	1.16	7.7
6	0100	0.58	3.9	0.95	3.9	0.86	8.2	80	1.15	4.1
	0700	0.69	4.9	0.88	4.9	0.84	4.8	42	1.13	4.8
	1300	0.60	5.3	0.83	5.3	0.86	5.3	50	1.13	5.6
	1900	0.56	5.3	0.70	9.9	0.67	8.9	68	0.88	10.6
7	0100	0.31	5.5	0.54	9.9	0.60	9.8	92	0.69	10.1
	0700	0.38	9.5	0.54	9.5	0.55	9.8	72	0.63	10.1
	1300	0.25	10.3	0.48	8.9	0.51	9.8	100	0.63	9.1
	1900	0.49	3.7	0.79	9.2	0.66	4.1	46	0.87	9.1
8	0100	0.54	4.8	1.04	5.1	1.18	5.6	90	1.33	5.1
	0700	0.99	6.6	1.55	6.8	1.71	7.1	76	1.90	6.7
	1300	1.02	8.1	1.83	8.1	2.12	8.2	64		
	1900	1.64	8.9	2.27	8.1	2.55	8.2	56		
9	0100	1.19	8.9	2.24	8.9	2.49	9.8	62		
	0700	1.61	9.9	2.22	10.3	2.43	10.8	68		
	1300	1.07	11.7	2.25	12.2	2.32	12.0	70	inoperative	
	1900	1.56	12.2	2.21	12.2	2.16	12.0	86		
10	0100	1.12	12.9	1.73	12.2	1.78	12.0	78		
	0700	1.11	11.7	1.60	11.7	1.67	12.0	92		
	1300	0.96	12.2	1.35	12.9	1.51	13.6	70		
	1900	1.00	12.9	1.42	13.5	1.48	12.0	72		

Table 4
Wave Data (continued)

Feb 1997										
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider	
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec
11	0100	0.83	12.9	1.25	12.9	1.28	12.0	86	inoperative	
	0700	1.05	5.9	1.26	11.7	1.42	12.0	90		
	1300	0.98	6.6	1.15	10.7	1.11	6.6	36		
	1900	0.76	6.1	0.94	10.3	0.98	10.8	62		
12	0100	0.59	5.9	0.72	10.3	0.75	10.8	84		
	0700	0.41	10.3	0.78	10.3	0.92	9.8	68		
	1300	0.43	11.7	0.82	11.2	0.80	10.8	64		
	1900	0.38	11.7	0.78	11.2	0.87	12.0	66		
13	0100	0.53	11.2	0.87	11.7	0.88	12.0	72		
	0700	1.26	6.0	1.85	6.1	1.84	6.2	44		
	1300	1.25	6.5	1.67	6.5	1.64	12.0	82		
	1900	0.96	6.3	1.52	12.2	1.54	12.0	68		
14	0100	0.94	6.1	1.34	6.1	1.43	12.0	72	inoperative	
	0700	0.94	8.1	1.84	7.8	1.96	8.2	92		
	1300	1.26	9.5	1.86	9.2	1.98	9.8	82		
	1900	0.88	8.9	1.44	9.5	1.47	8.9	106		
15	0100	0.77	9.2	1.29	8.3	1.23	8.9	106		
	0700	0.57	8.6	0.97	8.9	1.01	8.9	94		
	1300	0.51	9.5	0.92	8.9	0.87	8.9	76		
	1900	0.38	10.3	0.76	8.6	0.76	8.9	76		
16	0100	0.40	8.9	0.72	9.5	0.73	8.2	106		
	0700	0.46	3.8	0.91	4.0	0.88	4.2	42		
	1300	0.58	5.5	0.83	5.6	0.85	5.3	48		
	1900	0.36	5.2	0.66	7.8	0.64	8.9	80		
17	0100	0.28	9.9	0.51	9.9	0.49	9.8	106	inoperative	
	0700	0.64	4.4	1.00	3.8	1.38	5.6	40		
	1300	1.05	6.6	1.33	6.6	1.24	6.6	50		
	1900	0.65	5.9	0.98	6.3	0.83	6.6	52		
18	0100	0.47	5.3	0.70	6.1	0.73	6.6	36		
	0700	0.36	10.7	0.62	10.3	0.66	10.8	68		
	1300	0.30	10.3	0.71	10.7	0.81	9.8	62		
	1900	0.34	10.7	0.74	10.3	0.73	9.8	60		
19	0100	0.31	12.2	0.64	11.2	0.74	10.8	72		
	0700	0.34	11.2	0.62	11.7	0.65	10.8	70		
	1300	0.27	11.2	0.54	10.7	0.56	10.8	68		
	1900	0.27	12.2	0.49	11.7	0.52	12.0	94		
20	0100	0.24	11.2	0.44	11.7	0.47	10.8	84		
	0700	0.28	12.2	0.41	11.2	0.44	12.0	102		
	1300	0.21	10.3	0.36	11.2	0.40	10.8	104		
	1900	0.41	4.5	0.67	5.4	0.70	5.0	64		

Table 4
Wave Data (concluded)

Feb 1997										
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider	
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec
21	0100	0.35	9.9	0.72	5.2	0.67	10.8	100	inoperative	
	0700	0.38	4.6	0.69	4.9	0.63	4.6	48		
	1300	0.34	9.9	0.69	10.3	0.60	9.8	94		
	1900	0.61	6.8	0.85	6.8	0.86	6.6	112		
22	0100	0.47	7.4	0.72	7.6	0.72	7.6	108		
	0700	0.49	7.4	0.62	7.6	0.62	7.6	108		
	1300	0.30	7.2	0.50	9.9	0.51	8.9	84		
	1900	0.44	7.6	0.63	8.3	0.61	8.2	108		
23	0100	0.37	9.2	0.64	8.9	0.66	4.2	26		
	0700	0.70	5.3	1.00	4.9	0.98	5.0	34		
	1300	0.59	5.7	0.94	5.9	0.92	6.2	38		
	1900	0.52	5.6	0.75	5.9	0.74	5.3	28		
24	0100	0.25	10.3	0.52	9.9	0.53	9.8	102	inoperative	
	0700	0.26	10.3	0.47	8.9	0.48	9.8	102		
	1300	0.18	9.5	0.38	9.5	0.42	8.9	78		
	1900	0.27	8.9	0.42	8.1	0.44	8.2	106		
25	0100	0.18	8.9	0.35	9.9	0.38	8.9	78		
	0700	0.75	4.9	1.01	4.8	1.06	5.0	48		
	1300	0.69	6.1	1.02	6.1	1.01	6.6	38		
	1900	0.56	6.5	0.80	6.5	0.81	6.6	48		
26	0100	0.37	6.3	0.71	6.5	0.65	6.6	52		
	0700	0.28	9.5	0.53	8.9	0.51	8.2	82		
	1300	0.26	9.5	0.48	8.9	0.45	8.9	104		
	1900	0.49	5.5	0.71	5.5	0.75	5.9	124		
27	0100	0.53	8.3	0.74	8.3	0.80	7.6	108		
	0700	0.50	8.9	0.71	9.2	0.76	8.9	94		
	1300	0.41	8.6	0.60	8.1	0.58	7.6	108		
	1900	0.39	9.2	0.59	8.6	0.55	8.9	106		
28	0100	0.32	9.5	0.46	7.8	0.46	9.8	106	inoperative	
	0700	0.27	6.5	0.42	9.2	0.45	8.9	106		
	1300	0.27	9.5	0.39	9.5	0.43	9.8	106		
	1900	0.40	9.5	0.61	4.0	0.56	4.1	0		
Mean		0.59	8.5	0.93	8.7	0.96	8.9	74	1.05	8.8
Std dev		0.32	2.5	0.46	2.3	0.49	2.3	21	0.34	2.4

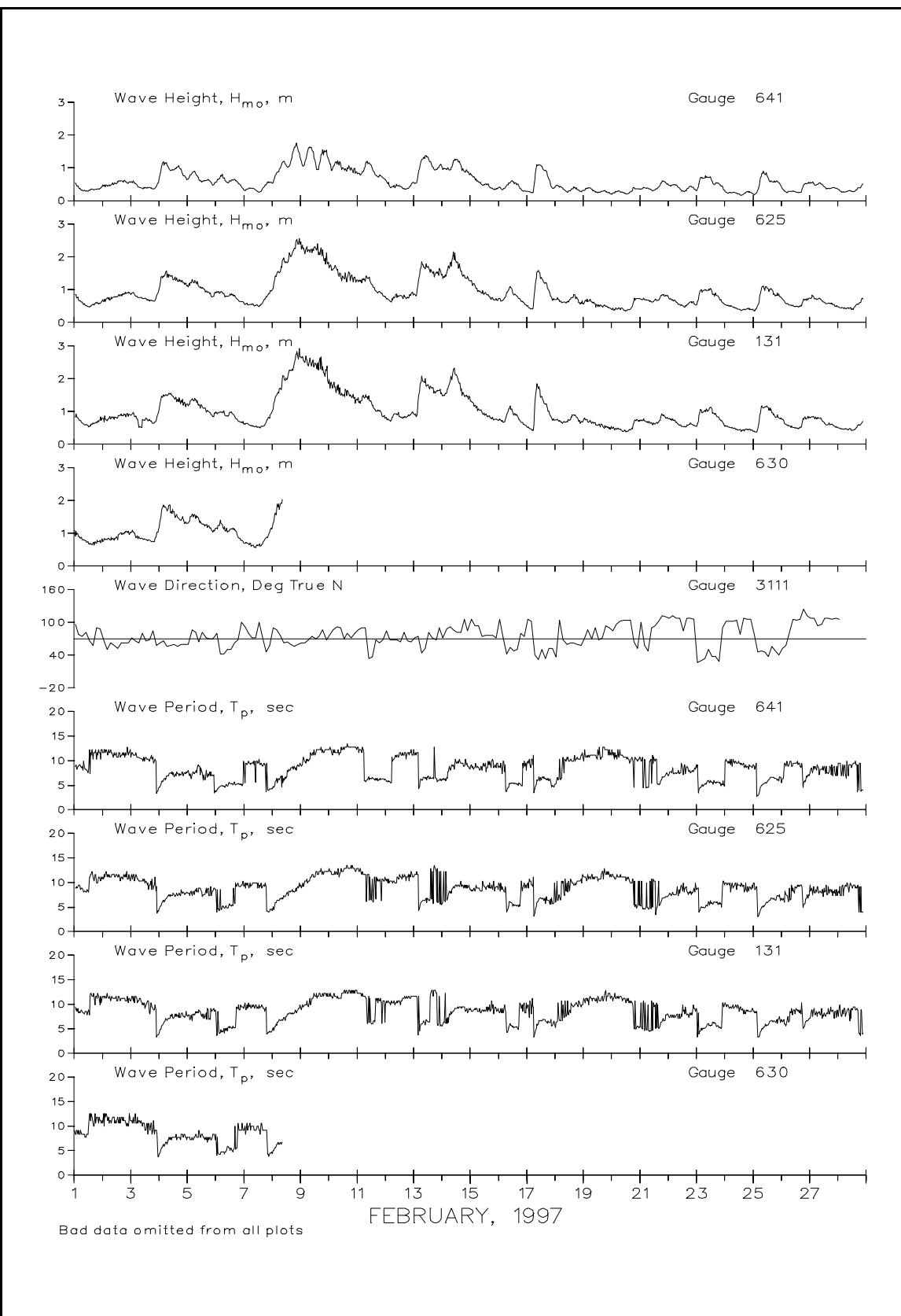


Figure 5. Wave Heights and Periods

Current Data

4

Current data (Table 5) are collected from a Marsh-McBirney electromagnetic biaxial current meter and by visually observing the movement of small drogues on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier, approximately 12 m offshore (Table 6).

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward). All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the cross-shore and longshore data. Current directions indicate the direction that the current is moving towards. Current data are plotted in Figure 2.

Table 5
Current Meter Data - Gauge 3539

FEBRUARY 1997											
		Cross	Long		Cross	Long		Cross	Long		
Day	Time	Shore	Shore	Speed	Dir	Shore	Shore	Speed	Dir	Shore	Shore
1	100			1300				20	100		
	700			1900					700		
	1300				11	100			1300		
	1900					700			1900		
2	100	Gauge		1300				21	100		
	700			1900					700		
	1300				12	100			1300		
	1900	inoperative				700			1900		
3	100			1300				22	100		
	700			1900					700		
	1300	entire			13	100			1300		
	1900					700			1900		
4	100			1300				23	100		
	700	month.		1900					700		
	1300				14	100			1300		
	1900					700			1900		
5	100			1300				24	100		
	700			1900					700		
	1300				15	100			1300		
	1900					700			1900		
6	100			1300				25	100		
	700			1900					700		
	1300				16	100			1300		
	1900					700			1900		
7	100			1300				26	100		
	700			1900					700		
	1300				17	100			1300		
	1900					700			1900		
8	100			1300				27	100		
	700			1900					700		
	1300				18	100			1300		
	1900					700			1900		
9	100			1300				28	100		
	700			1900					700		
	1300				19	100			1300		
	1900					700			1900		
10	100			1300					1900		
	700			1900							

KEY:

- +cross-shore = offshore, cm/sec
- cross-shore = onshore, cm/sec
- +longshore = south, cm/sec
- longshore = north, cm/sec
- Speed = Resultant speed, cm/sec
- Dir = Resultant direction, degrees true north

Table 6
Visually Observed Current Data

Feb 1997												
Day	Pier End				Mid-Surf Zone				Beach			
	Cross Shore	Long Shore	Speed	Dir	Cross Shore	Long Shore	Speed	Dir	Location	Speed	Dir	
1	21	-23	31	24	-1	-4	4	323	South	17	N	
2	-8	16	18	187	11	36	37	143	North	40	S	
3	14	68	69	149	33	47	57	125	North	39	S	
4	0	61	61	160	-20	68	71	177	no observation			
5	2	-8	8	351	3	-10	10	354	South	53	N	
6	0	87	87	160	-13	51	52	174	North	38	S	
7	-2	5	5	187	-3	-10	10	323	North	15	N	
8	0	44	44	160	13	51	52	146	North	18	S	
9	-20	68	71	177	9	61	62	151	North	23	S	
10	0	76	76	160	15	51	53	143	North	16	N	
11	11	44	45	146	-12	122	123	166	North	101	S	
12	-2	-11	11	331	12	-21	24	9	South	5	N	
13	-35	87	94	182	0	102	102	160	North	128	S	
14	-5	-23	24	329	-17	-87	89	329	South	37	N	
15	-7	68	68	166	-17	-87	89	329	South	37	N	
16	-11	38	40	177	-25	34	42	197	South	6	S	
17	0	0	0		12	122	123	154	North	55	S	
18	8	20	22	70	20	20	29	70	North	26	S	
19	18	-24	30	17	-11	-15	18	303	South	28	N	
20	-4	-6	7	303	-1	-5	5	151	North	15	N	
21	4	-11	12	2	-8	-5	9	218	North	27	N	
22	15	-61	63	354	-25	-55	61	316	South	21	S	
23	-7	44	44	169	0	87	87	160	SSS o	61	S	
24	10	20	22	133	0	0	0	0	North	15	N	
25	-15	61	63	174	-5	102	102	163	North	90	S	
26	0	-20	20	340	-4	-7	8	309	South	34	N	
27	9	-44	44	351	-17	-87	89	329	South	21	N	
28	13	-18	22	17	4	-24	25	349	South	49	N	

KEY:

- +cross-shore = offshore, cm/sec
- cross-shore = onshore, cm/sec
- +longshore = south, cm/sec
- longshore = north, cm/sec
- Speed = Resultant speed, cm/sec
- Dir = Resultant direction, degrees true north

Visual Observations

5

Visual wave direction measurements (Table 7) of both the primary wave train (i.e. that having the higher wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The pier axis (considered perpendicular to the beach at the FRF) is oriented 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and depth of visibility are also taken daily at the seaward end of the pier. A Bucket Thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The temperature is then read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the depth of visibility.

Table 7
Visual Observations

Feb 1997							
Day	Time	Wave Approach Angle at Pier End deg from True N		Water Characteristics at Pier End			
		Primary	Secondary	Width of Surf Zone,m	Temp.,C	Density g/cc	Secchi Vis.,m
1	1019	80		77	7.8	1.0232	1.5
2	0928	70		101	7.2	1.0225	1.8
3	0718	95	75	83	6.4	1.0169	1.2
4	0803	60		265	6.7	1.0177	0.9
5	0753	90		207	7.5	1.0220	0.9
6	0815	30		89	6.9	1.0205	1.2
7	0823	80		67	8.3	1.0201	2.1
8	0650	60		84	8.3	1.0210	0.3
9	0725	60	20	259	6.1	1.0166	0.3
10	0821	75		277	5.3	1.0207	1.5
11	0829	40		235	5.6	1.0202	0.6
12	0828	75	60	91	5.8	1.0192	1.2
13	0813	40		no obs	5.6	1.0226	0.3
14	0851	85		355	6.4	1.0224	0.6
15	0953	80		99	6.7	1.0213	0.9
16	1137	40		110	8.6	1.0198	1.5
17	1105	35		238	5.8	1.0195	0.9
18	0806	100	40	77	5.0	1.0196	1.8
19	0735	80	50	81	5.8	1.0234	0.9
20	0645	110		51	7.2	1.0247	1.2
21	0800	110	40	134	6.9	1.0160	2.4
22	0922	120		72	7.2	1.0252	0.9
23	1117	35		129	7.5	1.0254	0.6
24	0750	110	30	39	6.9	1.0204	2.4
25	0704	25		98	7.5	1.0205	0.9
26	0750	90	105	43	7.2	1.0212	1.8
27	0711	110		98	8.1	1.0246	0.6
28	0750	125		58	7.5	1.0258	2.1

Water Levels

6

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A NOS acoustic tide gauge (Next Generation Water Level Measurement System, NGWLMS) is used to collect water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 6 along with a list of means and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 8 contains the range, high, low, and mean water level for each 12.42-hr tidal cycle.

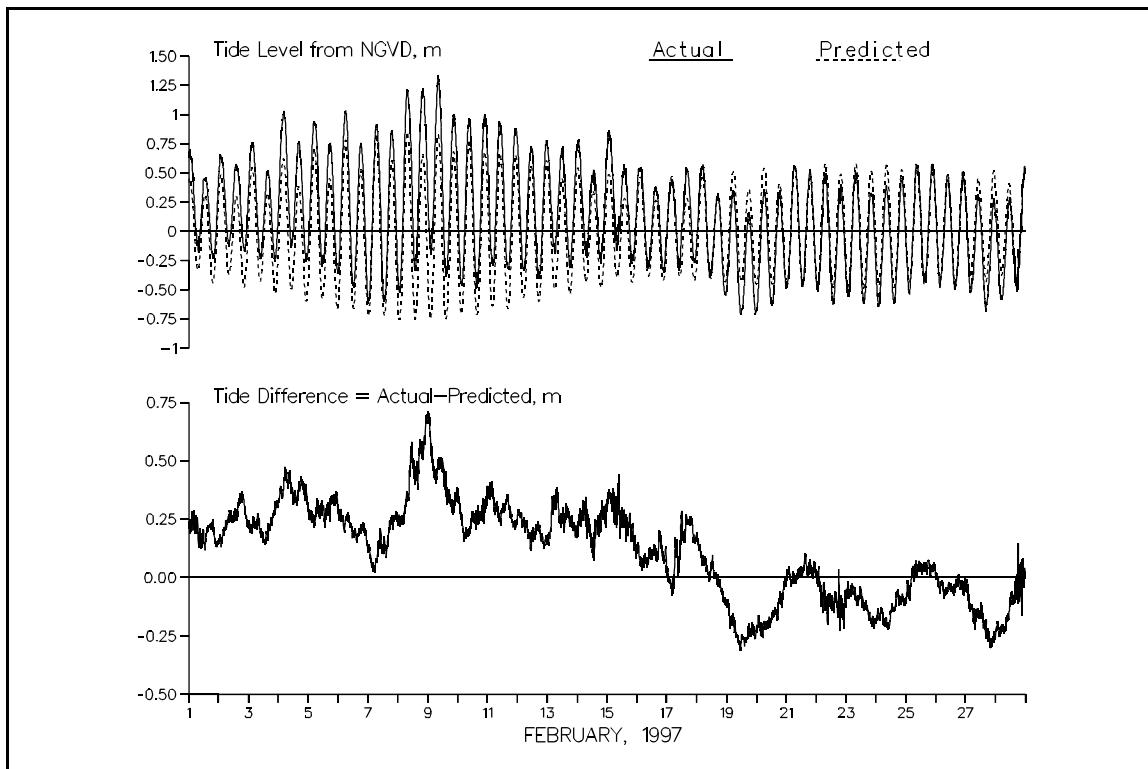


Figure 6. Water Level Variation

Table 8
Water Levels, m NGVD

FEB 1997 Tide Levels																
Day	High			Low			Mean	Range	High			Low			Mean	Range
	Time	m	Day	Time	m	Day			Time	m	Day	Time	m	Day		
1	0100	0.70	1	0742	-0.19	0.23	0.89	15	0136	0.87	15	0806	-0.17	0.36	1.04	
1	1330	0.46	1	1948	-0.24	0.13	0.70	15	1354	0.57	15	1942	-0.28	0.15	0.85	
2	0130	0.66	2	0800	-0.13	0.27	0.79	16	0312	0.55	16	0854	-0.32	0.13	0.87	
2	1424	0.58	2	2048	-0.17	0.22	0.75	16	1454	0.39	16	2136	-0.35	0.04	0.74	
3	0300	0.76	3	0936	-0.24	0.27	1.00	17	0342	0.44	17	0930	-0.34	0.11	0.78	
3	1606	0.52	3	2106	-0.26	0.16	0.79	17	1554	0.54	17	2212	-0.27	0.14	0.82	
4	0424	1.03	4	1030	-0.14	0.45	1.17	18	0512	0.57	18	1024	-0.39	0.10	0.97	
4	1654	0.77	4	2224	-0.26	0.26	1.03	18	1700	0.33	18	2324	-0.55	-0.12	0.88	
5	0506	0.94	5	1100	-0.30	0.33	1.25	19	0518	0.35	19	1130	-0.72	-0.20	1.07	
5	1800	0.76	5	2354	-0.37	0.21	1.12	19	1806	0.16	19	2324	-0.71	-0.27	0.87	
6	0600	1.03	6	1236	-0.48	0.28	1.51	20	0612	0.36	20	1230	-0.63	-0.15	0.99	
6	1812	0.76	7	0018	-0.62	0.08	1.38	20	1836	0.35	20	2354	-0.49	-0.09	0.84	
7	0648	0.92	7	1242	-0.61	0.17	1.52	21	0636	0.56	21	1254	-0.47	0.07	1.04	
7	1900	0.87	8	0112	-0.52	0.19	1.39	21	1912	0.53	22	0106	-0.52	0.01	1.05	
8	0736	1.22	8	1400	-0.34	0.47	1.56	22	0742	0.49	22	1336	-0.63	-0.06	1.12	
8	2024	1.22	9	0242	-0.20	0.54	1.42	22	2006	0.40	23	0142	-0.56	-0.08	0.96	
9	0812	1.33	9	1506	-0.39	0.47	1.72	23	0724	0.52	23	1348	-0.62	-0.05	1.15	
9	2106	1.01	10	0324	-0.47	0.28	1.48	23	2000	0.33	24	0218	-0.65	-0.14	0.98	
10	0930	0.97	10	1500	-0.49	0.25	1.46	24	0818	0.39	24	1430	-0.62	-0.11	1.01	
10	2130	1.00	11	0418	-0.29	0.34	1.30	24	2100	0.45	25	0300	-0.54	-0.02	0.99	
11	0948	0.94	11	1700	-0.33	0.29	1.27	25	0824	0.58	25	1500	-0.44	0.08	1.02	
11	2254	0.88	12	0506	-0.34	0.28	1.22	25	2142	0.58	26	0324	-0.49	0.06	1.07	
12	1112	0.73	12	1718	-0.40	0.17	1.13	26	0930	0.44	26	1530	-0.50	-0.02	0.95	
12	2318	0.78	13	0624	-0.19	0.29	0.98	26	2136	0.50	27	0412	-0.53	-0.02	1.03	
13	1212	0.73	13	1818	-0.32	0.21	1.04	27	1000	0.31	27	1606	-0.69	-0.18	1.00	
14	0112	0.79	14	0800	-0.22	0.30	1.01	27	2218	0.28	28	0442	-0.59	-0.18	0.87	
14	1318	0.53	14	1842	-0.28	0.16	0.80	28	1112	0.29	28	1718	-0.52	-0.10	0.81	

Bathymetry

7

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using a Trimble 4000 GPS for positioning, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 7 shows the last survey in December 1996 and the survey(s) in February 1997 on profile line 188, located 517 m south of the pier.

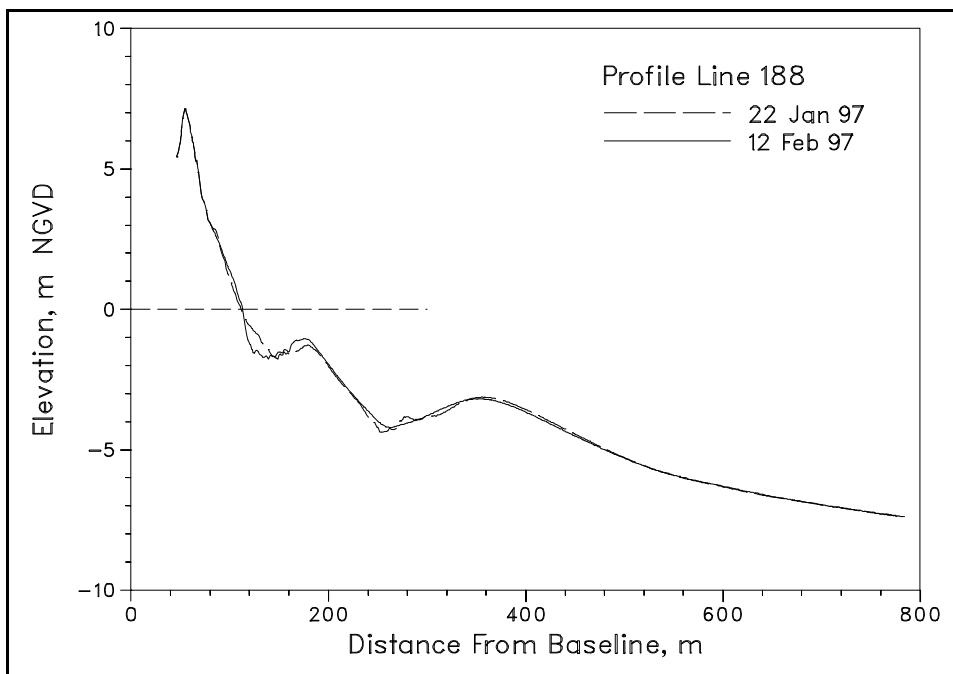


Figure 7. Monthly CRAB Profiles on Profile Line 188.

The profile envelope (Figure 8) reflects the maximum changes that occurred on the profile during 1997. Cross-hatched areas indicate changes to the annual envelope which occurred in February.

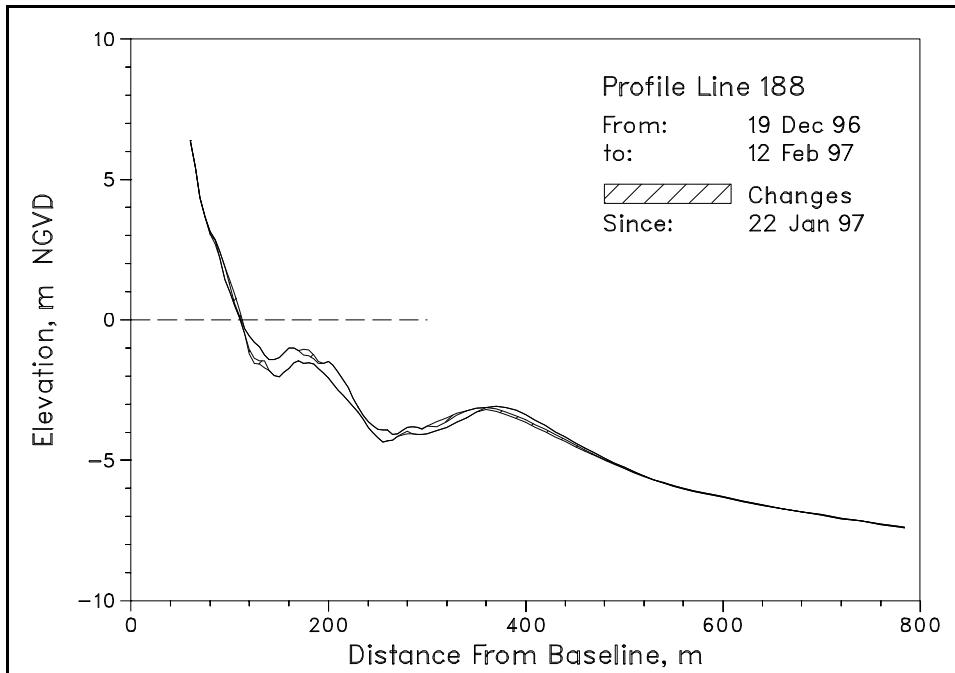


Figure 8. Profile Envelope - Profile Line 188.

B. Bathymetry. Figure 9 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 8 January. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

There was no bathymetric survey in February. Figure 9 is included for reference only.

Special Events

8

A. Storm Data Collection. The following list identifies times when the wave height H_{mo} at the seaward end of the pier exceeded 2 m.

<u>Start</u>	<u>End</u>
08 Feb (1408)	09 Feb (2116)
14 Feb (0842)	14 Feb (1034)

B. Storm Synopsis.

8-9 Feb Northeasterly winds were funneled between a Canadian high pressure system and a low pressure system over Cape Hatteras. Maximum onshore winds (NE) reached 18 m/s at 1934 EST on 8 February. The minimum atmospheric pressure was 1012 mb. The maximum H_{mo} , at gauge 625, reached 2.6 m ($T_p=9.8$ s) at 2234 EST on 8 February. There was 21 mm of precipitation.

14 Feb Winds associated with a cold front reached a maximum velocity (SE) of 14 m/s at 0700 EST. The atmospheric pressure was unaffected. The maximum H_{mo} , at gauge 625, reached 2.2 m ($T_p=9.1$ s) at 0916 EST. There was 12 mm of precipitation.